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The role of upper extremity strength and trunk control on performance-based manual wheelchair propulsion tests in individuals with a spinal cord injury

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Background The association between upper extremity (U/E) and trunk strength as well as seated postural stability with wheelchair propulsion performance has not been evaluated. Consequently, it remains unknown to what extent U/E and trunk strength and seated postural stability contribute to manual wheelchair propulsion performance. Gaining additional knowledge with regards to these modifiable contributors may provide guidance to rehabilitation professionals, particularly to physiotherapists, for selecting and prioritizing therapeutic interventions aiming to improve manual wheelchair performance, aside from those focusing on developing optimal propulsion techniques
Objective To quantify the association between performance-based manual wheelchair propulsion tests (i.e., 20-m propulsion test, slalom test, and 6-min propulsion test), trunk and U/E strength as well as seated reaching capability to establish which trunk and U/E strength or seated reaching capability measures best predict performance on timed manual wheelchair propulsion tests completed at discharge from inpatient rehabilitation by individuals with a spinal cord injury (SCI).
Methods Fifteen individuals with a SCI performed the 20-meter, slalom and 6-minute wheelchair propulsion tests within 72 hours prior to discharge from comprehensive inpatient SCI rehabilitation. Trunk and U/E strength along with seated reaching capability with unilateral hand support were also measured. The relationships between the wheelchair propulsion tests and the other variables were assessed using bi-variate correlation and multiple linear regression analyses.
Results The 20-meter propulsion-maximum velocity, slalom and 6-minute propulsion tests were moderately or strongly correlated with anterior and lateral inclination trunk strength, seated anterior reaching distance and the majority of shoulder, elbow and handgrip strength measures. Shoulder adductor strength-weakest side explained 53% of the variance on the 20-meter propulsion test-maximum velocity. Shoulder adductor strength-strongest side and forward seated reaching distance explained 71% of the variance on the slalom test. Handgrip strength explained 52% of the variance on the 6-minute propulsion test.
Conclusions U/E strength, especially of the shoulder adductors and handgrip, and forward seated reaching capability may be important determinants and predictors of performance during manual wheelchair propulsion tests. Specific rehabilitation interventions targeting these modifiable personal characteristics during rehabilitation may enhance manual wheelchair propulsion ability.
Keywords Muscle strength; Physiotherapy; Postural balance; Spinal cord injury; Manual wheelchairs
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Effect of wheelchair tires types and weight on wheelchair propulsion

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Background The number of manual wheelchair users in USA was estimated to 2.7 M individuals. Excessive loads to upper extremity joints are now a growing concern, causing possible loss of independence and increased healthcare cost. Consequently, there is a strong interest in clinical practice to reduce the mechanical effort to propel a wheelchair. The manual wheelchair tires being the interface between the wheelchair itself and the surface, their physical properties then become variables of great importance for which clinicians have few relevant data on to guide their interventions.
Objective To determine the impact wheelchair propulsion of tire type, tire profile, wheelchair load, wheelchair type, tire pressure, and their interactions.
Method To achieve our goal, we measured the distance traveled when a standardized push was applied by a mechanical propelling system for 2 wheelchair types (rigid frame and foldable), 3 urethane solid tire types with different profiles and 2 pneumatic tire types with different profiles at 100% and 75% of the manufacturer's recommended pressure. This was done for all possible wheelchair configurations at 48.0, 75.4, 98.2 and 123.1 kg of mass added to the wheelchair.
Results On average, solid tires ran 39% less distance ($p < 0.001$), regardless of any other parameter. This effect remains clearly pronounced at all masses, although the relative impact increases with mass (31% at 48 kg and 41% at 123.1 kg, [$p < 0.0001$]). Secondly, the foldable wheelchair showed up to 32% less rolling distance ($p < 0.001$) at lower added mass than the rigid frame wheelchair. This advantage is negligible at 98.2 kg and 123.1 kg. Finally, tire pressure and tire profile were shown to be, at best, of higher order effects.
Discussion Wheelchair users and clinicians have two options to reduce efforts related to wheelchair propulsion, by opting for pneumatic tires and/or rigid frame wheelchairs. Impact of those two parameters is less important for heavier wheelchair users.
Keywords Wheelchair; Tire type; Propulson
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The SCI Community Survey: Highlights related to met or unmet needs for services after return in community living

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Background and objectives The SCI Community Survey is the largest consumer survey of its type ever undertaken in Canada (n = 1549 participants including 412 with a non-traumatic lesion).